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Art. XII.—*Geological Notes on Neumerella, and the Section from Bairnsdale to Orbost.*

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(With Plate X.)

[Read 9th July, 1925.]

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I.—Introductory.

The following notes are based on some observations and collections made during an official visit to Neumerella in May, 1915. The Orbost railway line was then under construction, and from the fact that some large fossil casts had been found[1] during the work of excavation in the cuttings, it was evident that the beds there exposed were highly fossiliferous. I was accordingly deputed to explore this new locality in the hope of obtaining some interesting material for the National Museum collections.

The excavations for the Orbost railway showed that a vast deposit of marly limestone extends under the old coastal plain between the Lakes and the Snowy River. My own observations prove, however, that the fauna is practically the same as that of the lower part of the Bairnsdale series, and also shows strong faunal affinities with the Lower Murray Cliffs. There is here recorded for the first time a fairly long list of the smaller organisms, comprising Foraminifera and Ostracoda, groups which have not hitherto received much attention from those compiling local faunas, but which have their particular zonal value.

II.—Previous References to Lower Cainozoic Fossils of Bairnsdale Area.

A list of 23 species of fossils from the banks of the Mitchell River was given by J. Dennant (1891A), which he afterwards increased to more than 60 (1891B).

1.—These fossils were collected by the late Mr. Andrew Kincaid, of the Victorian Railways, to whom I was much indebted for practical help during my short stay at Neumerella.

A comprehensive paper dealing with all the fossiliferous localities of the Lower Mitchell area was published in 1903 by J. Dennant and Donald Clark (1903). The localities therein described in detail belong to the Janjukian and Kalimnan stages, and there appears to be an intermediate one which has not yet been established, but of which there is evidence in the collections at the National Museum. The fossil records from this paper are apparently all included in the next paper referred to.

Dennant and Kitson (1904) published a Catalogue of Cainozoic Fossils from the Mitchell River. This list does not include Polyzoa or Foraminifera.

As regards the Polyzoa, MacGillivray (1895) had already enumerated a large assemblage of species from the Bairnsdale Tertiaries, but that author did not give any indication of the precise locality of the material, nor of the horizon.

A later author on the polyzoa, C. M. Maplestone (1898), does, however, state the locality as Mitchell River, Bairnsdale. In all probability MacGillivray's specimens came from the same place, since it was then easy of access and rich in that material. Maplestone subsequently (1904) gave a list of Polyzoa, with a Table of Mitchell River species.

III.—Fossils collected at Neumerella, near Orbost.

(a) *Characters of the Fossil Bed.*

The fossils collected by myself from May 28th to June 2nd, 1915, in the railway construction works, occurred in a marly limestone of a rich yellow to ochreous colour. A good opportunity was then afforded to examine the details of stratification, since some of the cuttings were deep and the sides fairly clean. Certain bands were apparently rich in remains of cetaceans and fishes, and these, with the fossil crustacea, undoubtedly contribute the appreciable amount of P_2O_5 to be found in this limestone.

Many of the mollusca had their shells well preserved, and distributed along particular bands; but in other cases, where there had been local solution, the shells had been entirely removed. This was especially the case among the larger forms, as the great volutes and *Nautilus*. The dissolved calcic carbonate had in these cases been re-deposited in the neighbourhood, and often over impervious bands, in the form of clusters of dog's tooth spar, whilst some of the hollow shells themselves were filled with the crystals.

(b) *Age of the Bed.*

From an examination of the accompanying list of fossils it will be seen that the fauna is typically Janjukian.

The sharks' teeth, *Isurus retroflexus* and *Odontaspis incurva* are normally Janjukian, though they are known in the basal Kalimnan or remanié beds in Victoria.

The ostracoda recorded are closely matched by the fauna already described by the author from the polyzoal limestone of the Mallee Bores.

Nautilus geelongensis is common in and restricted to the Janjukian, with one exception, known from the Kalimnan of Grange Burn.

Ostrea ingens, Chlamys flindersi and *C. eyrei,* are all restricted Janjukian forms of mollusca.

Among the brachiopods, *Terebratella portlandica* is a Janjukian species.

One of the most conspicuous of the polyzoa is *Cellepora biradiata,* which has hitherto been recorded only from Mount Gambier, whilst it is here noted as well from the River Murray Cliffs, Corio Bay, and Muddy Creek, lower beds.

The tube-worm, *Serpula ouyenensis,* is a typical Janjukian fossil of the Mallee, which has also lately been described from New Zealand by H. Finlay, M.Sc. (1924, p. 449); the New Zealand localities are Pukeuri (Awamoan or Upper Miocene) and Clifden, Southland (Lower Miocene). *Ditrupa cornea,* var. *wormbetiensis* is most commonly found in the Janjukian (Miocene), although not entirely confined to that series.

Of the echinoids, *Cidaris* (*Leiocidaris*) *australiae* is a Janjukian form, along with *Arachnoides* (*Monostychia*) *australis, Eupatagus murrayensis,* and the two forms, *Pentagonaster* and *Antedon.*

Restricted Janjukian corals are seen in *Mopsea tenisoni* and *M. hamiltoni,* whilst the calcareous sponge, *Plectroninia,* has before been found only on the Lower Moorabool and at Flinders.

Of the foraminifera, many species have been noted from other Janjukian localities, such as of Batesford, Torquay, and the Mallee Bores (polyzoal series), although a proportion of them occur also in the Balcombian beds. There, however, they are usually thin-shelled and micromorphic, but in the Neumerella deposits, as in common with other Janjukian strata, they are well proportioned and robust.

(c) *List of Fossils.*

Note.—In the following list of 150 species and varieties, those new to the Mitchell River series are marked with an asterisk. Species herein described and noted in detail are marked †.

CETACEA.

Spp. indet. Vertebrae and fragments of rib-bones.
(One specimen represents two conjoined cervical vertebrae of about the dimensions and form of those seen in a full-grown Killer Whale, *Orca.*)

PISCES.

*†*Carcharias* (*Prionodon*) *aculeatus,* Davis sp.
*†*Squatina gippslandicus,* Chapman and Cudmore.

* *Carcharodon megalodon*, Agassiz.
(Two specimens purchased, one nearly 4½ inches (112·5 mm.) in height.)
* *Odontaspis contortidens*, Ag.
* „ *incurva*, Davis sp.
* *Isurus retroflexus*, Ag. sp.
* „ cf. *desorii*, Ag. sp.
* „ *hastalis*, Ag. sp.
(In the possession of the workmen, but examined and determined.)

BRACHYURA.

Carapaces of (?) Ocypoda.
Appendage joints of portunids and other slender chelae.

OSTRACODA.

* *Macrocypris decora*, G. S. Brady.
* *Bythocypris tumefacta*, Chapman.
* *Bairdia amygdaloides*, G. S. B.
* „ *australis*, Chapman.
* „ *forcolata*, G. S. B.
*† „ *minutissima*, sp. nov.
* *Cythere dictyon*, G. S. B.
*† „ *kincaidiana*, sp. nov.
* „ *scutigera*, G. S. B.
* „ *stimpsoni*, G. S. B.
* „ *parallelogramma*, G. S. B.
* „ *quadriaculeata*, G. S. B.
* „ *rastromarginata*, G. S. B.
* „ *wyrille-thomsoni*, G. S. B.
* *Xestoleberis margaritea*, G. S. B.
* *Cytherella pulchra*, G. S. B.
* „ *punctata*, G. S. B.
(Most of these species are figured in my Report on the Mallee Bores.) (Chapman, 1916.)

CEPHALOPODA.

* *Nautilus geelongensis*, Foord.
(A fine cast of a large example was donated to the Museum by Mr. G. S. Rees, of the Victorian Railways. Other specimens were also found by the author.)

GASTEROPODA.

*†*Megatebennus concatenatus*, Crosse and Fischer sp., var. *pyrula*, nov.
*†*Calliostoma semioraata*, sp. nov.
Turritella murrayana, Tate.
* „ *conspicabilis*, Tate.
„ *tristira*, Tate.
*†*Vermicularia funicalis*, Crespin, var. *conferta*, nov.
(?) *Verconella* or (?) *Fasciolaria* sp. (cast).
Cassis exigua, T. Woods.
Cypraea leptorhyncha, McCoy.
* „ *subsidua*, Tate.
(Casts of this species are very common. They represent the gerontic stage of the shell.)
*†*Cypraedia* sp.
(A somewhat similar but undescribed form is found in the Balcombian beds. The present example is in the form of a cast.)

* *Pterospira validicostata*, Dennant and Kitson.
(This specific name is a nom. mut. for *P. alticostata*, Tate sp. The examples are chiefly in the form of casts, often of large size.)

PELECYPODA.

* *Glycymeris gunyoungensis*, Chapman and Singleton.
(Closely matches the variety found at Fyansford. Occurs as a cast.)
* *Glycymeris ornithopetra*, Chapm. and Singl.
(Also occurring as casts.)
Cucullaea corioensis, McCoy.
Dimya dissimilis, Tate.
Lima bassi, T. Woods.
Spondylus pseudoradula, McCoy.
Ostrea ingens, Zittel.
„ *hyotidoidea*, Tate.
* *Modiolus latecaudatus*, Pritchard sp.
Chlamys murrayana, Tate sp.
* „ *polymorphoides*, Zittel sp.
„ *foulcheri*, T. Woods sp.
* „ *flindersi*, Tate sp.
„ *sturtiana*, Tate sp.
* „ *eyrei*, Tate sp.
Pseudamussium yahliensis, T. Woods sp., var. *semilaevis*, McCoy var.
Cardium victoriae, Tate.
* „ ?*septuagenarium*, Tate.
Chama lamellifera, T. Woods.
Antigona dimorphophylla, Tate sp. (Cast.)
* *Callanaitis multitaeniata*, Tate sp. (Cast.)
* *Dosinia johnstoni*, Tate.
?*Teredo* or *Kuphus* sp.

BRACHIOPODA.

Terebratulina suessi, Hutton.
* „ *catinuliformis*, Tate.
* *Terebratella portlandica*, Chapm.
Terebratula tatcana, T. Woods.
Magadinella woodsiana, Tate sp.
Magellania garibaldiana, Davidson sp.
„ cf. *crouchii*, T. Woods sp.

POLYZOA.

Ditaxipora intermedia, Waters sp.
Cellaria contigua, MacGillivray.
„ *rigida*, MacGill.
* „ „ var. *venusta*, MacGill.
„ *angustiloba*, Busk sp.
* „ cf. *marginata*, Mönster sp. (fide Stoliczka).
Lepralia burlingtoniensis Waters.
* *Selenaria cupola*, T. Woods sp.
Bipora cancellata, Busk sp.
„ *philippinensis*, Busk sp.
Cribrilina sp.
Porina gracilis Milne Edw. sp.
Smittia tatei, T. Woods sp.
*† *Cellepora biradiata*, Waters.
† „ *coronopus*, Searles Wood (=*gambierensis*, Busk).
† „ *fossa*, Haswell sp. (Also a complanate var. of the same.)
Adeona mucronata, MacGill.

* *Idmonea serialis*, Stol.
„ *divergens*, MacGill.
* „ *?venusta*, MacGill.
„ *hochstetteriana*, Stol. sp., var. *bairusdalei*, MacGill.
* „ *incurva*, MacGill.
Retepora bairusdalei, MacGill.
„ *subimmersa*, MacGill.

VERMES.

* *Ditrupa cornea*, Linné sp., var. *worumbetiensis*, McCoy.
* *Serpula ouyenensis*, Chapman.
(Also Mallee Bores and New Zealand Tertiaries.)

ECHINODERMATA.

* *Cidaris* (*Leiocidaris*) *australiae*, Duncan.
Paradoxechinus novus, Laube.
Clypeaster gippslandicus, McCoy.
Arachnoides (*Monostychia*) *australis*, Laube sp.
* „ „ „ var. *elongata*, Duncan.
Eupatagus murrayensis, Laube.
* *Pentagonaster* sp.
* *Antedon* sp.

ANTHOZOA.

* *Mopsea tenisoni*, Chapman.
* „ *hamiltoni*, Thomson sp.
Flabellum gambierense, Duncan.

SPONGIAE.

* *Plectroninia halli*, Hinde.

FORAMINIFERA.

* *Miliolina tricarinata*, d'Orb. sp.
* „ *agglutinans*, d'Orb. sp.
* „ *trigonula*, Lamarck sp.
*† *Jaculella neumerellensis*, sp. nov.
* *Haplophragmium sphaeroidiniforme*, Brady.
* *Textularia gibba*, d'Orb.
* „ „ var. *tuberosa*, d'Orb.
* „ *abbreviata*, d'Orb.
* *Spiroplecta sagittula*, Defrance sp.
* *Clavulina communis*, d'Orb.
* „ *parisiensis*, d'Orb., var. *humilior*, Brady.
* *Gaudryina rugosa*, d'Orb.
* „ *pupoides*, d'Orb.
* *Bolivina nobilis*, Hantken.
* *Nodosaria raphanus*, Linné sp.
* „ *scalaris*, Batsch sp.
* „ (*Dentalina*) *consobrina*, d'Orb.
* „ „ „ var. *emaciata*, Reuss.
* „ „ *farcimen*, Soldani sp.
* „ „ *obliqua*, Linné sp.
* „ „ *adolphina*, d'Orb. sp.
* *Lingulina* cf. *costata*, d'Orb.
* *Cristellaria cultrata*, Montf. sp.
* *Polymorphina elegantissima*, Parker and Jones.
* „ *gibba*, d'Orb.
* „ *compressa*, d'Orb.
* „ *communis*, d'Orb.

* *Globigerina bulloides*, d'Orb.
* „ *triloba*, Reuss.
* *Discorbina pileolus*, d'Orb. sp.
* *Truncatulina lobatula*, Walker and Jacob sp.
* „ *ungeriana*, d'Orb. sp.
* „ *refulgens*, Montf. sp.
* *Anomalina ammonoides*, Reuss sp.
* *Pulvinulina repanda*, F. and M. sp.
* „ *elegans*, d'Orb. sp.
* „ *karsteni*, Reuss sp.
* *Rotalia clathrata*, Brady.
* „ *soldanii*, d'Orb.
* *Nonionina depressula*, W. and J. sp.
* *Polystomella craticulata*, F. and M. sp.
* *Operculina complanata*, Defr.
* „ „ var. *granulosa*, Lem.
* „ *ammonoides*, Gron. sp.

IV.—Description of New and Rare Species.

Class PISCES.

Family CARCHARIIDAE.

Genus **Carcharias**, Cuvier.

Sub-genus **Prionodon**, Müller and Henle.

CARCHARIAS (PRIONODON) ACULEATUS, Davis sp.

Galeocerdo aculeatus, Davis, 1888, Trans. Roy. Dublin Soc., [2], iv., p. 8, pl. i., figs. 1-3.

Carcharias (*Prionodon*) *aculeatus*, Davis sp., Chapman and Cudmore, 1924, Proc. Roy. Soc. Vic., n.s., xxxvi. (2), p. 119, pl. ix., figs. 19, 20.

Observations.—The Neumerella specimens found by me are referred to in the paper recently published by Mr. F. Cudmore and myself as being "very well preserved and . . . identical with Davis's type specimens from the Miocene of Coleridge Gully, Trelissick Basin, New Zealand." We have there shown that the species ranges from the Balcombian to the Kalimnan in Victoria (Oligocene to Lower Pliocene).

Family SQUATINIDAE.

Genus **Squatina**, Aldrovandi.

SQUATINA GIPPSLANDICA, Chapman and Cudmore.

Squatina gippslandica, Chapman and Cudmore, 1924, Proc. Roy. Soc. Vic., n.s., xxxvi. (2), p. 136, pl. xi. fig. 47.

Observations.—The example of a tooth named above was found on this present collecting expedition to Neumerella. The genus was before unknown as a fossil from the Australian region.

Class CRUSTACEA.

Super-Order OSTRACODA.

Family BAIRDIIDAE.

Genus **Bairdia**, McCoy.

BAIRDIA MINUTISSIMA, sp. nov.

(Plate X., Figs. 2*a,b*.)

Description.—Co-types, right and left separated valves. Carapace seen from the side, subovate, rotund; dorsal margin well rounded, ventral nearly straight, curving posteriorly to meet the dorsal in a blunt point, and anteriorly sharply rounded and truncate towards the dorsal. Edge view of carapace ovate, compressed at the extremities. Surface very finely areolate. Muscle area well defined when moistened, resembling that of a typical *Bairdia*.

Dimensions.—Length, 1 mm.; height of carapace, ·77 mm.; thickness of carapace, ·77 mm.

Observations.—In outline this species resembles a form like *Bairdia fovclata*, G. S. Brady (1880. p. 55, pl. viii., figs. 1*a-f*, 2*a-f*), but with rounder extremities.

Family CYTHERIDAE.

Genus **Cythere**, O. F. Müller.

CYTHERE KINCAIDIANA, sp. nov.

(Plate X., Figs. 1*a-c*.)

Description.—Holotype, a right valve. Seen from the side, sub-rectangular, wider anteriorly, with a flexuose dorsal and nearly straight ventral margin. The anterior margin is broadly rounded, sub-truncated towards the dorsal and generally depressed, with a sub-marginal row of quadrate alveolae. Posterior margin rounded, denticulated with blunt processes and bearing a long sharp spine at the postero-dorsal angle. The surface of the valve gradually rises from the dorsal line to the ventral, and in the postero-median area culminates in a crested process, which merges into a sharp low keel anteriorly, and rapidly disappears posteriorly. The surface from the ventral keeled area to the dorsal is relieved with moderately large areolae arranged in more or less longitudinal lines parallel with the dorsal margin. Carapace in edge view sub-rhomboidal, with the ventral crest measuring nearly one half the height of the valve. Carapace in end view sub-cordate, with salient dorsal spine.

Dimensions.—Length of valve, 1·54 mm.; height of valves, ·84 mm.; thickness of carapace, 1·2 mm.

Observations.—This remarkably ornate ostracod is quite unlike anything met with either in the Australian Tertiary or elsewhere. One of the nearest related forms as to ornament is *Cythere velivola,* G. S. Brady (1880, p. 111, pl. xxiii., figs. 4*a-c*), in which, however, the surface ornament is pustulate instead of areolate, and the extremities are much more spinose.

Class GASTEROPODA.

Family FISSURELLIDAE.

Genus **Megatebennus**, Pilsbry.

MEGATEBENNUS CONCATENATUS, Crosse and Fischer sp., var. PYRULA, nov.

(Plate X., Fig. 3.)

Description.—This variety differs from the typical species in having a distinctly pear-shaped apical fissure and coarser pittings of the external shell-surface.

The type of the variety here figured from Neumerella is somewhat angulated in outline.

Observations.—With some reluctance the above example is separated as a new variety, for the species is variable, but not to so great an extent as in the co-ordination of the two characters mentioned in the description. This variety is also found at Fyansford (Dennant Coll.) in beds which I hold to be of similar age, that is, Janjukian.

The species has a remarkable geological range (from Oligocene to Newer Pliocene), and is also living in Port Phillip and Western Port, Victoria.

Occurrence.—Janjukian (Miocene). In limestone, Neumerella, near Orbost, E. Gippsland.

Family TROCHIDAE.

Genus **Calliostoma**, Swainson.

CALLIOSTOMA SEMIORNATA, sp. nov.

(Plate X., Figs. 5, 6.)

Description of Holotype, from Muddy Creek.—Shell conical, apex acute; base flattened or slightly convex. Umbilicus small, open. Mouth sub-quadrate. Shell consists of ten whorls and a smooth protoconch of one and a-half turns. Whorls flat, with about 13 smooth or faintly crenulate lirae and usually with an intermediate finer one. Whorls flat; keel strong, prominent and granulose. Base with about 13 spiral, laminate lirae. In the first whorls there are fine vertical lines of growth which cross the spiral lirae, resulting in a clathrate ornament. This clath-

ration extends into the other whorls but in a lessening degree, and then only in the prominent area beneath the sutural keel of the preceding whorl.

Apical angle of spire, 50°.

Dimensions of Holotype.—Height, 22 mm. Width at base, 21 mm.

Description of Paratype, from Neumerella.—This is a mould of a larger example, showing by a wax squeeze similar ornament to the above. The diameter of the body whorl is about 31 mm.

Observations.—The nearest living forms to *C. semiornata* are *C. nobilis*, Philippi and *C. latecarinata*, Swainson. In these forms, however, the ornament is granulose rather than filiform and clathrate. *Calliostoma suteri* var. *fragile*, Finlay (1923), is a New Zealand fossil form that approaches the present one, but differs in the shorter spire and fewer lirae.

From *C. millegranosa*, Pritchard, this species differs in the sharper keels, the finer lirae, the threadlike growth lines, and the narrower apical angle, which in Pritchard's species is 70°.

Occurrence.—Holotype. Muddy Creek (lower beds). Balcombian. Coll. by Mr. Broomfield (Nat. Mus. Coll.).

Paratype. From Neumerella, near Orbost. In yellow limestone. Janjukian. A mould of a larger example.

Family VERMETIDAE.

Genus **Vermicularia**, Lamarck.

(Plate X., Fig. 4*a-b*.)

VERMICULARIA FUNICALIS, Crespin, var. CONFERTA, nov.

Description.—The present specimens are a fairly constant variation on the above species (Crespin, 1926). They are distinguished by having a more densely coiled shell, which is usually attached to a molluscan shell-fragment or other object, whilst the free, uncoiled portion usually seen in this and allied species is wanting. The shell-surface is similarly finely corrugated as in the specific form.

Dimensions.—Greatest diameter of type of var., 9 mm. Height, 5 mm.

Observations.—The specific form is known from Keilor, Curlewis and the Gellibrand River, all in the Janjukian series, to which the Neumerella outcrop belongs.

Occurrence.—Several examples from the ferruginous and marly limestone of Neumerella, near Orbost. Janjukian.

Family CYPRAEIDAE.

Genus **Cypraedia**, Swainson.

CYPRAEDIA sp.

Observations.—The above genus seems appropriately to include those forms of *Trivia*-like shells which have the parallel or

slightly anastomosing riblets confined to the basal portion; and moreover, with a tendency for the spire to be more or less exsert.

A cast of such an example occurs in the Neumerella collection, but since it only slightly indicates the costate character, it cannot be used as a type for description.

A probably allied form is represented in the National Museum collection from the Balcombian beds of Port Phillip, but is not yet described.

The Neumerella cast measures—Length, 39 mm.; width, 26 mm.; height, 23 mm.

The *Trivia pompholugota* of Tate (1890, p. 214), found in the Adelaide Bore, appears to be a similar type of shell, but has a less exsert spire and is very much smaller.

Class POLYZOA.

Family CELLEPORIDAE.

Genus **Cellepora**, Fabricius (*emend.* Busk).

CELLEPORA CORONOPUS, Searles Wood.

Cellepora coronopus, S. V. Wood, 1850, Ann. and Mag. Nat. Hist., xiii., p. 18. Busk, 1859, Pal. Soc. Mon. for 1857, Crag Polyzoa, p. 57, pl. ix., figs. 1-3. Waters, 1879, Ann. and Mag. Nat. Hist., [5], iii., p. 192. Searles Wood, Waters, 1885, Quart. Journ. Geol. Soc., xli. p. 302.

Cellepora gambierensis, Busk, 1860, Quart. Journ. Geol. Soc., xvi., p. 261 (*nomen nudum*). T. Woods, 1862, Geological Observations in South Australia, pp. 74 and 85 (description of zoarium only). T. Woods, 1865 (1861), Trans. and Proc. Roy. Soc. Vic., vi., p. 4, No. 3.

Celleporaria gambierensis, Busk sp., Stoliczka, 1864, Novara Exped., Geol. Theil., i. (2),—Fossil Bryozoa of Orakei Bay, p. 141, pl. xx., fig. 7.

Observations.—After long consideration and a comparison with authentic English Crag specimens in the National Museum, I am convinced of the con-specific standing of the English and Australian forms. Stoliczka suggested a similar identity for the New Zealand Miocene fossils. Waters (*loc. supra cit.*, 1885, p. 303), commenting on a badly preserved specimen from Aldinga, South Australia, states that "so far as this specimen permits a judgment, I certainly agree with him" (i.e., Stoliczka).

In the majority of cases the zoaria of the Australian Miocene examples are much larger than the English specimens, but all gradations in size can be found.

Tenison Woods records this form (under *C. gambierensis*) as attaining the enormous length of 10 or 12 feet, and I have also

observed it in the polyzoal limestone at Torquay of almost similar extent.

The detailed characters of the zooecia are comparable with *C. coronopus,* and the solidity and roundness of the branches, together with the tapering form of the extremities, are convincing data.

Occurrence.—*C. coronopus* is found generally in the polyzoal limestone of Australia, as in the Murray Cliffs and at Aldinga, in South Australia; at Torquay and in the Mallee Bores in Victoria; and at Table Cape, Tasmania.

At Neumerella it is commonly represented by fairly large ramose examples.

Cellepora biradiata, Waters.

(Plate X., Figs. 8, 9.)

Cellepora biradiata, Waters, 1885, Quart. Journ. Geol. Soc., xli., p. 306, pl. vii., figs. 11, 12.

Observations.—For many years collectors of Murray River fossils have been acquainted with the above species, though not by name, and it does not appear to occur in any list beyond that of the original author. Waters has figured the broken dorsal surface of the zoarium, and also the whole of the concave, dorsal or under-surface, to show the double radiating lines.

C. biradiata seems to approach *C. tridenticulata,* var. *nummularia* in shape, but the character of the dorsal radii and the mamillated upper zooecial surface are quite sufficient distinction; moreever the proximal margin of the zooecium in *C. biradiata* is without the three narrow teeth seen in *C. tridenticulata,* var. *nummularia.*

Occurrence.—This species is quite a common form in the Murray River Cliffs, S. Australia. The largest specimen in the National Museum measures in its incomplete state, 106 mm. in diameter, and is 67 mm. in height (about $4\frac{1}{4}$ x $2\frac{3}{4}$ inches). One example in the National Museum, from the collection of the Geological Survey of Victoria, was obtained from Corio Bay in the early days of the Survey.

Several examples are included in the Dennant Coll. (Nat. Mus.) labelled "Muddy Creek, older." Judging by the matrix, these evidently came from the upper part of the lower beds (Balcombian); the largest specimen has a diameter of 47 mm.

At Neumerella the specimens are abundant, and of large size, one having a diameter of 64 mm.

Cellepora fossa, Haswell sp.

Sphaeropora fossa, Haswell, 1881, Proc. Linn. Soc. N.S. Wales, v., p. 42, pl. iii., figs. 5, 6.

Cellepora fossa, Haswell sp., Waters, 1881, Quart. Journ. Geol. Soc., xxxvii., p. 343. Id., 1882, ibid., xxxviii., p. 275. Id., 1885, ibid., xli., p. 307. MacGillivray, 1895. Trans. Roy. Soc. Vic., iv., p. 108, pl. xiv., figs. 8-10.

Observations.—MacGillivray regarded this species as a *small* form, "about 5 mm. in diameter," but there are some examples in the MacGillivray Coll. (Nat. Mus.) which are twice this diameter. Waters records a specimen from the Murray River Cliffs "about 25 mm. in diameter," with the "one surface which may be called the under surface, flat; the other is slightly rounded. On the flat surface there are about forty well-marked pits and a few smaller ones."

A specimen in the National Museum collection, from Bairnsdale, has a diameter of 35 mm., and on the flat surface there are about 32 pits. These may have been occupied by similar organisms to the small red actinids found by Haswell occupying cylindrical pits in recent *Cellepora*.

It is of especial interest to note the extensive range in time of this species, for it occurs in the Balcombian of Victoria, thence through the Janjukian of Victoria and South Australia, and again in Recent deposits, but in lower latitudes, as might be expected, off the Queensland Coast.

The fossil occurrences of *Cellepora fossa* are:—

Balcombian.—Balcombe Bay; Muddy Creek (lower beds), Victoria.

Janjukian.—Mount Gambier; Murray River Cliffs; Aldinga, South Australia.

Cape Otway; Curdie's Creek; Shelford; Fyansford; Moorabool River (Griffin's); Bird Rock Cliffs, Torquay; Waurn Ponds; Bairnsdale; Neumerella, Victoria.

Class RHIZOPODA.

Order FORAMINIFERA.

Family ASTRORHIZIDAE.

Genus **Jaculella**, H. B. Brady.

JACULELLA NEUMERELLENSIS, sp. nov.

(Plate X., Fig. 7.)

Description.—Texture arenaceous, consisting of an irregular, tubular test, slightly tapering at both extremities, with the sides irregularly swollen towards the middle. The aboral end commences with a finely arenaceous, white, bulbous chamber, so characteristic of the sub-family Rhabdammininae. Oral aperture circular. Test of a pale ochreous colour.

Dimensions.—Length, 5 mm.; greatest breadth, ·54 mm.

Observations.—This species is curiously like the recent *Jaculella obtusa* figured by Brady in the Challenger Report (1884), on plate xxii., fig. 20. His recent species came from the Faröe Channel, at depths of 350 and 542 fathoms. It differs from the recent species in being fusiform rather than tapering, whilst the texture is finely arenaceous. I have already figured a fossil specimen of *Jaculella*

(*J. ?obtusa,* Brady) from the Balcombian (Oligocene) of Grice's Creek, Port Phillip (Chapman, 1907), but this is nearer the typical *J. obtusa,* and, moreover, does not show the commencement.

Occurrence.—Janjukian. Neumerella, in washings from the limestone.

V.—Stratigraphical Notes on the Area.

From Bairnsdale to the Nicholson River and beyond, the railway passes through low cuttings which reveal a monotonous section of "Torrent Gravels." These, as I have elsewhere shown, are post-Kalimnan, and probably represent the Werrikooian or Upper Pliocene stage in this area (Chapman, 1918, p. 168, et seq. Also Hart, 1921, pp. 75-82). The gravels contain derived pebbles and boulders of silicified wood, presumably of Kalimnan age or even older, and the deposits well represent the products of the denuding agencies which were at work during a time of uplift, when the present land surface was at a far greater elevation than at present.

At the Nicholson River, where the bridge crosses at a height of 48 feet above sea-level, the succession is seen as a basal limestone covered by fine Kalimnan sands, whilst over all lies the sheet of gravel. These fine sands are replaced elsewhere by lake and shore deposits of fossiliferous ironstone, as at Boggy and Moitun Creeks where they contain casts of Kalimnan shells.

The Janjukian marls and limestones are exposed on both sides of the Nicholson River. Through the cuttings, from Bombara and Mossiface to Bruthen, the same torrent gravel is seen, but the underlying rock, which is a pink granite, is not in evidence until one approaches the Mississippi Creek. This granite can be traced as far as Mundic Creek, and is evidently part of the Gabo Island massif, which rock it resembles in having bright red felspar, but which is here even more vivid.

The railway line from Bairnsdale to Nowa Nowa appears to cut through an East and West sunkfield at the base of the foothills, since only the gravels are seen, until Colquhoun is reached. These Torrent Gravels again form the prevailing beds in the sections in the cuttings, until Tostaree is reached. A little to the East of Hospital Creek the Janjukian marly limestone now outcrops from beneath the gravels and underlying sands, and it was here that a very fine tooth of *Carcharodon megalodon*[2] was obtained by one of the excavators in the Railway Construction Camp.

The whole of the succeeding part of the line to Neumerella, cutting across Wombat Creek and Dinner Creek, is in the Janjukian limestone, and it was from the Neumerella end that the present collection was made. The elevated land overlooking the Snowy River Flats, as shown by the section revealed in the railway cutting, seems to be due to a warp-fold structure, where the

2.—Now in the National Museum Collection.

Miocene rocks have been differentially uplifted above the base-levelled plain of the Snowy River foothills This elevated mass of harder rock, of the Miocene limestone, although not marked on the geological map (Everett's, 1902), is really an extension of the Bairnsdale massif, the trend-line of which is about due W. to E., but which from Boggy Creek is seen to be diverted slightly to the N.E. That the elevated strip of the older Tertiary is not continuous is seen by the occurrence of drowned valleys crossing it, as at Lakes Entrance; whilst the submergence of such rivers as the Nicholson and the Tambo belongs to the sunkfield area in the back country to the north.

In the case of the Nicholson River the bed is exceptionally depressed, for 80 feet of alluvial and marine muds were penetrated during the pile driving for the railway bridge, which was then being carried out.

That local folding and faulting has taken place in the East Gippsland coastal country, is frequently demonstrated in the cuttings near the Neumerella end of the Orbost railway. Two sketch sections were made in the cutting, the first of which bears out this point.

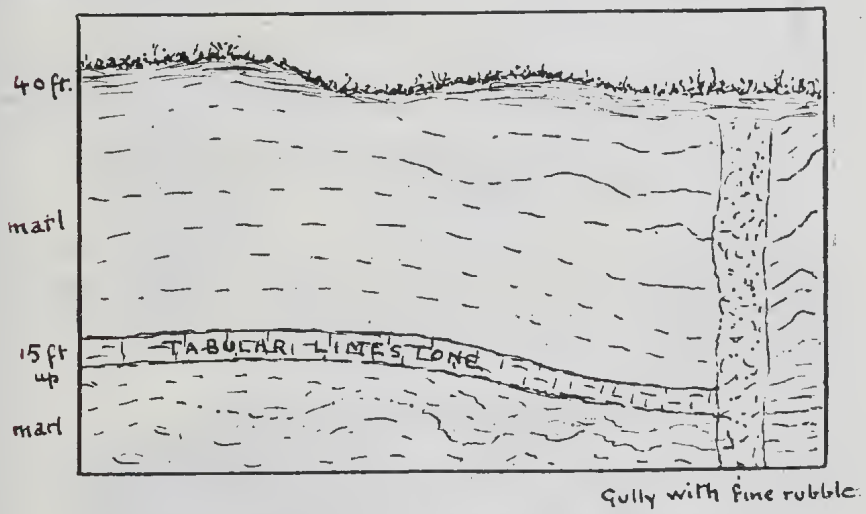

FIG. 1.—Section in Rly. cutting at 22m. 37ch. from Nowa Nowa, towards the head of the line. Showing faulting and folding in the Janjukian Series.

In this section (Fig. 1) there is a vertical thickness of 40 feet of marls and marly limestone. From the base to 15 feet above the marl bed is crumpled or folded. Then comes a band of marly limestone about 2′6″, which shows a major fold. Above this is another marl bed, about 25 feet thick, more gently folded, and dipping towards a fracture line or rift, now filled with fine rubble and sandy clay. This apparent fault occupies the lowest point in the dip of the marl beds.

The section in Fig. 2 shows the general distribution of the fossiliferous bands in the marl beds, together with the intercalated tabular limestone. At the base of the cutting was found the fine cast of a large *Nautilus geelongensis,* now exhibited in the wall case at the National Museum.

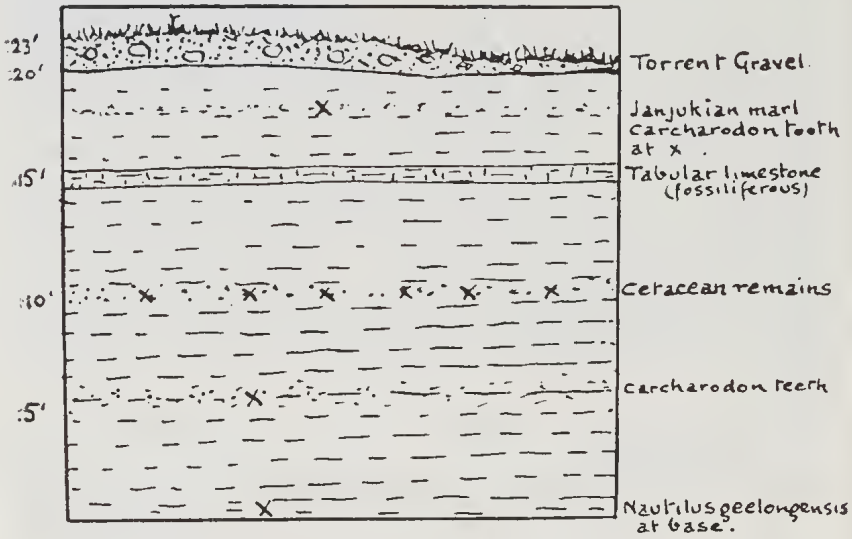

Fig. 2.—Section in Rly. cutting at 23m. 18ch. from Nowa Nowa, towards the head of the line. Janjukian marls and Torrent Gravels.

Teeth of sharks (*Carcharodon*) were found about 5 feet up in the section, cetacean remains at 10 feet, and *Carcharodon* again at about 18 feet. Surmounting this Janjukian bed is the unconformable sheet of Torrent Gravel, about 3 feet in thickness.

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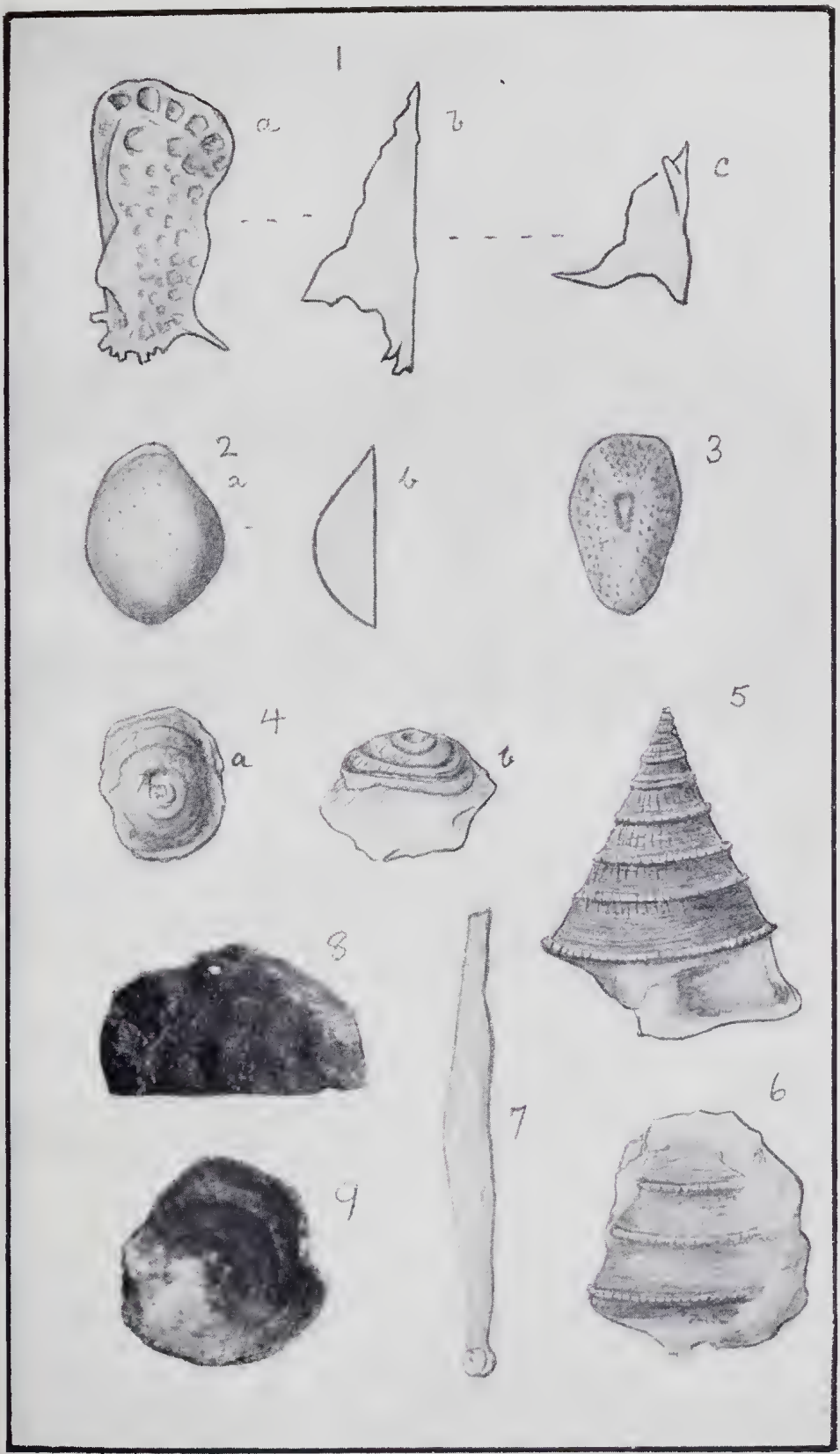

F.C. del. et photo.

Cainozoic Fossils, Neumerella.